

# Table of Contents

	<u>Page:</u>
<b>TABLE OF CONTENTS.....</b>	<b>III</b>
<b>TABLE OF FIGURES.....</b>	<b>V</b>
<b>TABLE OF TABLES.....</b>	<b>VI</b>
<b>CHAPTER 1 – EXECUTIVE SUMMARY .....</b>	<b>1</b>
SECTION 1.1 - INTRODUCTION .....	2
<b>CHAPTER 2 - THE MANHATTAN ROUNDABOUT .....</b>	<b>5</b>
SECTION 2.1 – ROUNDABOUT GEOMETRY .....	5
SECTION 2.2 – HOURLY TRAFFIC VOLUMES .....	5
SECTION 2.3 – MINI TRAFFIC CIRCLES IN MANHATTAN, KANSAS .....	10
SECTION 2.4 - LOCAL PRINT MEDIA COVERAGE.....	11
<i>Section 2.4.1 - Focus of Local Print Media.....</i>	<i>11</i>
<i>Section 2.4.3 – Article Summaries – Roundabouts.....</i>	<i>11</i>
<b>CHAPTER 3 – EXPERIMENTAL DESIGN .....</b>	<b>13</b>
SECTION 3.1 – VIDEO DATA COLLECTION .....	13
SECTION 3.2 – MANUAL DATA COLLECTION .....	15
SECTION 3.3 – COMPARABLE INTERSECTIONS .....	15
SECTION 3.4 – DATA ANALYSIS.....	16
<b>CHAPTER 4 – COMPARABLE INTERSECTIONS.....</b>	<b>18</b>
SECTION 4.1 – DICKENS AVENUE/ WREATH AVENUE (DW) .....	18
SECTION 4.2 – JULIETTE AVENUE/ PIERRE STREET (JP) .....	22
SECTION 4.3 – COMPARISON OF TRAFFIC VOLUMES AT THE THREE STUDY INTERSECTIONS .....	26
<b>CHAPTER 5 – SAFETY .....</b>	<b>28</b>
SECTION 5.1 – LITERATURE REVIEW .....	28
<i>Section 5.1.1 - Safety of Roundabouts .....</i>	<i>28</i>
<i>Section 5.1.2 - Bicycle and Pedestrian Safety .....</i>	<i>29</i>
<i>Section 5.1.3 - Bicycle and Pedestrian Design.....</i>	<i>29</i>
SECTION 5.2 – CRASH REVIEW .....	30
SECTION 5.4 – CONFLICT ANALYSIS – LITERATURE REVIEW .....	31
SECTION 5.5 – CONFLICT ANALYSIS – CG, DW AND JP.....	33
SECTION 5.5 – INTERSECTION TRAVEL SPEED .....	33
SECTION 5.6 – SUMMARY OF SAFETY EVALUATION .....	33
<b>CHAPTER 6 – TRAFFIC VOLUME AND DELAY.....</b>	<b>34</b>
SECTION 6.1 – DAILY TRAFFIC VOLUMES.....	34
SECTION 6.2 – INTERSECTION DELAY .....	34
SECTION 6.3 - DELAY AT THE MANHATTAN ROUNDABOUT .....	35
<b>CHAPTER 7 – SIDRA ANALYSIS.....</b>	<b>36</b>
<b>CHAPTER 8 – STATISTICAL ANALYSIS OF ROUNDABOUT AND COMPARABLE INTERSECTIONS – ANALYSIS I.....</b>	<b>37</b>
SECTION 8.1 – STATISTICAL ANALYSIS OF SIDRA HOURLY TRAFFIC VALUES (I) .....	39

<b>SECTION 8.2 – STATISTICAL ANALYSIS OF SIDRA OUTPUT FOR ROUNDABOUT AND COMPARABLE INTERSECTIONS</b>	
(I).....	40
<i>Section 8.2.1 – Statistical Analysis of 95 Percentile Queue (I)</i> .....	40
<i>Section 8.2.2 – Statistical Analysis of Average Delay (I)</i> .....	44
<i>Section 8.2.3 – Statistical Analysis of Maximum Approach Delay (I)</i> .....	47
<i>Section 8.2.4 – Statistical Analysis of Proportion Stopped (I)</i> .....	50
<i>Section 8.2.5 – Statistical Analysis of Maximum Proportion Stopped (I)</i> .....	53
<i>Section 8.2.6 – Statistical Analysis of Degree of Saturation (I)</i> .....	56
<i>Section 8.2.7 – Summary of Statistical Analysis of SIDRA Output (I)</i> .....	58
<b>CHAPTER 9 – STATISTICAL ANALYSIS OF CANDLEWOOD DRIVE/ GARY AVENUE</b>	
<b>INTERSECTION – ANALYSIS II.....</b>	<b>60</b>
SECTION 9.1 – 95 PERCENTILE QUEUE AT CANDLEWOOD DRIVE/ GARY AVENUE (II) .....	60
SECTION 9.2 – AVERAGE DELAY FOR CANDLEWOOD DRIVE/ GARY AVENUE (II).....	63
SECTION 9.3 – MAXIMUM APPROACH DELAY FOR CANDLEWOOD DRIVE/ GARY AVENUE (II) .....	66
SECTION 9.4 – PROPORTION STOPPED FOR CANDLEWOOD DRIVE/ GARY AVENUE (II) .....	69
SECTION 9.5 – MAXIMUM PROPORTION STOPPED FOR CANDLEWOOD DRIVE/ GARY AVENUE (II) .....	72
SECTION 9.6 – STATISTICAL ANALYSIS OF DEGREE OF SATURATION (II) .....	74
SECTION 9.7 – SUMMARY OF STATISTICAL ANALYSIS II .....	76
<b>CHAPTER 10 – SUMMARY AND CONCLUSIONS .....</b>	<b>77</b>
SECTION 10.1 – STUDY SUMMARY .....	77
SECTION 10.2 – CONCLUSIONS .....	78

## Table of Figures

	<u>Page:</u>
FIGURE 1 - ROUNDABOUT IN MANHATTAN, KANSAS .....	5
FIGURE 2 - UNITED STATES ROUNDABOUTS AND ENTERING TRAFFIC VOLUMES .....	6
FIGURE 3 - CANDLEWOOD DRIVE/ GARY AVENUE - APPROACH TRAFFIC COUNTS .....	9
FIGURE 4 - CUMULATIVE FREQUENCY DISTRIBUTION OF TRAFFIC COUNTS - CANDLEWOOD DRIVE/ GARY AVENUE	10
FIGURE 5 - MANHATTAN, KANSAS MINI TRAFFIC CIRCLE .....	11
FIGURE 6 - OMNIDIRECTIONAL VIDEO CAMERA MOUNTED TO STREET LIGHT POLE.....	13
FIGURE 7 - VIDEO RECORDING ASSEMBLY.....	14
FIGURE 8 - DICKENS AVENUE/ WREATH AVENUE – TOTAL APPROACH TRAFFIC COUNTS .....	20
FIGURE 9 - CUMULATIVE FREQUENCY DISTRIBUTION OF TRAFFIC COUNTS - DW .....	22
FIGURE 10 - JULIETTE AVENUE/ PIERRE STREET – TOTAL APPROACH TRAFFIC COUNTS.....	24
FIGURE 11 - CUMULATIVE FREQUENCY DISTRIBUTION - JULIETTE AVENUE/ PIERRE STREET.....	26
FIGURE 12 - COMPARISON OF ENTERING VOLUMES AT THE THREE STUDY INTERSECTIONS .....	27
FIGURE 13 – STANDARD INTERSECTION CONFLICT POINTS .....	31
FIGURE 14 - ROUNDABOUT INTERSECTION CONFLICT POINTS.....	31
FIGURE 15 – 95 PERCENTILE QUEUE VALUES (I) .....	42
FIGURE 16 - AVERAGE VEHICLE DELAY (I).....	45
FIGURE 17 - MAXIMUM APPROACH AVERAGE VEHICLE DELAY (I).....	48
FIGURE 18 - PROPORTION STOPPED (I) .....	51
FIGURE 19 - MAXIMUM APPROACH PROPORTION STOPPED (I) .....	54
FIGURE 20 - DEGREE OF SATURATION (I) .....	57
FIGURE 21 – 95 PERCENTILE QUEUES (II) .....	62
FIGURE 22 - AVERAGE VEHICLE DELAY (II) .....	64
FIGURE 23 - MAXIMUM APPROACH AVERAGE VEHICLE DELAY (II) .....	67
FIGURE 24 - PROPORTION STOPPED (II) .....	70
FIGURE 25 - MAXIMUM APPROACH PROPORTION STOPPED (II).....	73
FIGURE 26 - DEGREE OF SATURATION (II).....	75

## Table of Tables

	<u>Page:</u>
TABLE 1 - ROUNDABOUT DESIGN SPEED AND APPLICATION .....	2
TABLE 2 - COUNT DATA - CANDLEWOOD DRIVE/ GARY AVENUE .....	7
TABLE 3 - CANDLEWOOD DRIVE/ GARY AVENUE APPROACH COUNTS .....	8
TABLE 4 - CANDLEWOOD DRIVE/ GARY AVENUE 85 PERCEITILE APPROACH SPEEDS .....	9
TABLE 5 - COMPARABLE INTERSECTION SELECTION CRITERIA .....	16
TABLE 6 - INTERSECTION MEASURES OF EFFECTIVENESS .....	16
TABLE 7 - DICKENS AVENUE/ WREATH AVENUE APPRAOCH TRAFFIC COUNTS .....	19
TABLE 8 - DICKENS AVENUE/ WREATH AVENUE 85 PERCENTILE APPRAOCH SPEEDS .....	20
TABLE 9 - DICKENS AVENUE/ WREATH AVENUE TRAFFIC COUNT DATA .....	21
TABLE 10 - JULIETTE AVENUE/ PIERRE STREET APPRAOCH TRAFFIC COUNTS.....	23
TABLE 11 - JUILIETTE AVENUE/ PIERRE STREET 85 PERCENTILE APPRAOCH SPEEDS.....	24
TABLE 12 - JULIETTE AVENUE/ PIERRE STREEET TRAFFIC COUNT DATA.....	25
TABLE 13 - SAFETY AND OPERATIONAL CONCERNS OF ROUNDABOUTS .....	28
TABLE 14 - CRASH RECORDS BEFORE AND AFTER ROUNDABOUT INSTALLATION .....	30
TABLE 15 - BEFORE AND AFTER CRASH COSTS AT ROUNDABOUT .....	30
TABLE 16 - BASIC INTERSECTION CONFLICTS - STANDARD INTERSECTION AND ROUNDABOUT CONTROL .....	32
TABLE 17 - STATISTICAL TEST SUMMARY OVERVIEW .....	38
TABLE 18 - STATISTICAL TEST SUMMARY OF SIDRA TRAFFIC VOLUMES (I) .....	39
TABLE 19 - SUMMARY STATISTICS OF SIDRA TRAFFIC VOLUMES (I) .....	39
TABLE 20 - 95 PERCENTILE QUEUE VALUES (I) .....	41
TABLE 21 - STATISTICAL TEST SUMMARY OF 95 PERCENTILE QUEUE (I) .....	43
TABLE 22 - 95 PERCENTILE MEAN AND STANDARD DEVIATION (I) .....	43
TABLE 23 - AVERAGE VEHICLE DELAY (I) .....	44
TABLE 24 - STATISTICAL TEST SUMMARY FOR AVERAGE VEHILCLE DELAY (I).....	46
TABLE 25 - AVERAGE VEHICLE DELAY MEAN AND STANDARD DEVIATION (I) .....	46
TABLE 26 - MAXIMUM APPROACH AVENAGE VEHICLE DELAY (I).....	47
TABLE 27 - STATISTICAL TEST SUMMARY FOR MAXIMUM APPROACH DELAY (I) .....	49
TABLE 28 - MAXIMUM APPROACH DELAY MEAN AND STANDARD DEVIATION (I) .....	49
TABLE 29 - PROPORTION STOPPED (I) .....	50
TABLE 30 - STATISTICAL TEST SUMMARY FOR PROPORTIN STOPPED (I) .....	52
TABLE 31 - PROPORTION STOPPED MEAN AND STANDARD DEVIATION (I).....	52
TABLE 32 - MAXIMUM APPROACH PROPORTION STOPPED (I) .....	53
TABLE 33 - STATISTICAL TEST SUMMARY FOR MAXIMUM APPROACH STOPPED (I).....	55
TABLE 34 - MAXIMUM PROPORTION STOPPED MEAN AND STANDARD DEVIATION (I).....	55
TABLE 35 - DEGREE OF SATURATION (I) .....	56
TABLE 36 - STATISTICAL TEST SUMMARY FOR DEGREE OF SATURATION (I).....	58
TABLE 37 - DEGREE OF SATURATION MEAN AND STANDARD DEVIATION (I) .....	58
TABLE 38 - SUMMARY OF MOE STATISTICAL RESULTS - ANALYSIS I .....	58
TABLE 39 - 95 PERCENTILE QUEUES (II) .....	61
TABLE 40 - STATISTICAL TEST SUMMARY FOR 95 PERCENTILE QUEUES (II) .....	62
TABLE 41 - 95 PERCENTILE QUEUE MEAN AND STANDARD DEVIATION (II) .....	63
TABLE 42 - AVERAGE VEHICLE DELAY (II).....	63
TABLE 43 - STATISTICAL TEST SUMMARY FOR AVERAGE DELAY (II).....	65
TABLE 44 - AVERAGE DELAY MEAN AND STANDARD DEVIATION (II).....	65
TABLE 45 - MAXIMUM APPROACH AVERAGE VEHICLE DELAY (II) .....	66
TABLE 46 - STATISTICAL TEST SUMMARY FOR MAXIMUM APPRAOCH DELAY (II) .....	68
TABLE 47 - MAXIMUM APPROACH DELAY MEAN AND STANDARD DEVIATION (II) .....	68
TABLE 48 - PROPORTION STOPPED (II) .....	69
TABLE 49 – STISTICAL TEST SUMMARY FOR PROPORTION STOPPED (II).....	70
TABLE 50 - PROPORTION STOPPED MEAN AND STANDARD DEVIATION (II) .....	71
TABLE 51 - MAXIMUM APPROACH PROPORTINO STOPPED (II).....	72
TABLE 52 - STATISTICAL TEST SUMMARY FOR MAXIMUM APPROACH STOPPED (II) .....	73

TABLE 53 - MAXIMUM APPROACH STOPPED MEAN AND STANDARD DEVIATION (II) .....	74
TABLE 54 - DEGREE OF SATURATION (II) .....	74
TABLE 55 - STATISTICAL TEST SUMMARY FOR DEGREE OF SATURATION (II) .....	76
TABLE 56 - DEGREE OF SATURATION MEAN AND STANDARD DEVIATION (II) .....	76
TABLE 57 - SUMMARY OF MOE STATISTICAL RESULTS - ANALYSIS II.....	76
TABLE 58 - SUMMARY OF MOE STATISTICAL RESULTS - ANALYSIS I.....	77
TABLE 59 - SUMMARY OF MOE STATISTICAL RESULTS - ANALYSIS II.....	78

## Appendices

APPENDIX 1 - ADVISORY COMMITTEE

APPENDIX 2 - ANNOTATED BIBLIOGRAPHY

APPENDIX 3 - SAMPLE SIDRA RESULTS, CANDLEWOOD DRIVE / GARY AVENUE

APPENDIX 4 - SAMPLE SIDRA RESULTS, DICKENS AVENUE / WREATH AVENUE

APPENDIX 5 - SAMPLE SIDRA RESULTS, JULIETTE AVENUE / PIERRE STREET

APPENDIX 6 - LOCAL NEWS ARTICLES

